



GSM-Based Smart Home Technology

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ABSTRACT –

Smart homes are becoming increasingly popular due to the convenience, comfort, and security they offer. Smart home technology provides the ability to control and monitor various devices and appliances within the home, as well as providing home security features. This paper provides a comparative analysis of smart home systems based on four different technologies: GSM, IoT, Bluetooth, and PIC Microcontroller with ZigBee modulation. The analysis considers factors such as ease of setup, functionality, security, and cost.

Keywords – Smart home technology, Internet of Things (IoT), Bluetooth, Zigbee, Wi-Fi, Raspberry Pi, GSM.

INTRODUCTION

Smart home technology has become popular in recent years, and with the advent of new technologies, the options for creating a smart home have increased. Smart home systems provide the ability to control and monitor various devices and appliances within the home, as well as provide home security features. There are many different technologies available for smart home systems, including GSM, IoT, Bluetooth, and PIC Microcontroller with ZigBee modulation.

GSM-based systems use the cellular network to control and monitor various devices and appliances. IoT-based systems use the internet to connect various devices and appliances. Bluetooth-based systems use Bluetooth technology to connect various devices and appliances. PIC Microcontroller with ZigBee modulation-based systems use a microcontroller and ZigBee technology to connect various devices and appliances.

This paper provides a comparative analysis of these four different technologies based on various factors such as ease of setup, functionality, security, and cost. The analysis aims to provide insights into the strengths and weaknesses of each technology to help users make informed decisions.

METHODOLOGIES

A. GSM based smart home technology

The system is built by using PIC16F887 microcontroller that uses Global System for Mobile communication (GSM) for controlling home appliances through Short Messaging Service(SMS). GSM technique is used due to high transmission quality, and communicates through SMS, and MMS messages. This system has additional costs for the messages. The disadvantages of the system are that the messages sent by the devices require networks if there is no network the SMS may be delayed, and the user is not able to program the devices.

The smart home technology consists of A AVR microcontroller with a GSM network that sends SMS for controlling devices. The system contains AVR code that can be interpreted by the microcontroller. The user can write commands that are sent through the messages. The microcontroller instructs the driver circuit to control the devices at home from any part of the world. The disadvantage is that it cannot turn in real-time systems.

The home appliances are controlled by the Global System for Mobile Communication home automation technique by the SMS or the messages sent. As shown in figure1, the Arduino with device drivers and relays is used to control and monitor devices. To develop the user interface, visual programming is used that sends the messages depending on the commands to the GSM modems. It has a pre-programmed interface, high cost, and messages are not sent in real-time are the disadvantages of the system.

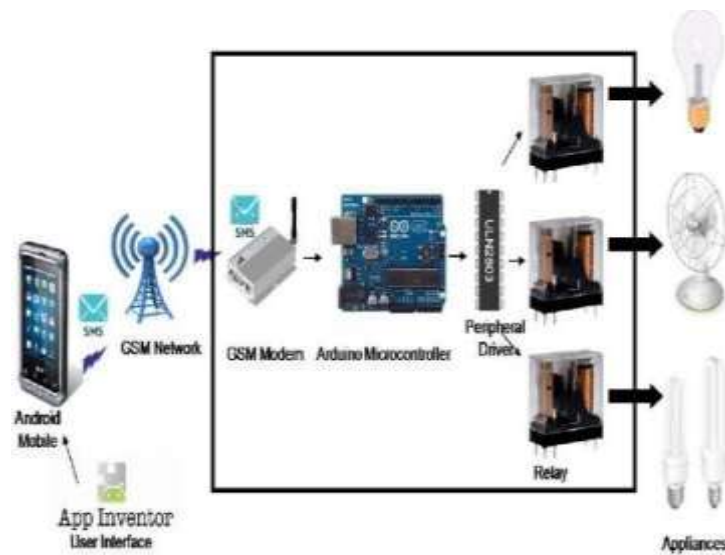


Figure1: GSM based smart home technology

B. ZigBee-based smart home technology

The system contains ZigBee wireless device module, GPRS module, ARM microcontroller, and camera to monitor and control devices at home. It also consists of an MQ-2 smoke device, a PIR device, and sensors. It provides security and manages the activities of the device at home. Zigbee devices can transmit data over long distances by passing data through networks of intermediate devices to reach more distant ones. The home appliances such as air conditioners, lights, and TV functions and activities are sent to the microcontroller through the Zigbee wireless devices, this information is sent to smartphones in real-time through the GPRS networks. Zigbee is able to control and monitor the complex architecture of home appliances.

The disadvantages of this system are low transmission rate and expensive.

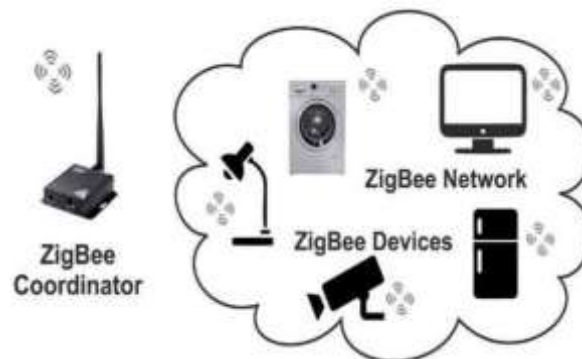


Figure2: ZigBee-based smart home technology

The system uses ZigBee wireless communication technology to control home automation appliances. For this purpose, the PIC microcontroller and voice recognition is used. The voice commands which are taken from a mike are compared with a voice store and processed. The commands are transmitted by the PIC microcontroller through ZigBee to the receiver. The command in the receiver unit is processed by another PIC microcontroller. It consists of Relays for controlling purposes. The Smoke detector is also implemented so if the smoke is found it will send messages or alerts to the mobile number of the user. Disadvantages are the ZigBee used is of low transmission rate and low range communication device.

C. Bluetooth-based Smart Home Technology

The System uses Bluetooth technology to control, monitor and protect the home appliances. The client is a PC that is connected through USB to the Bluetooth Module, Pulse with modulation, and a sensor circuit. The connected Bluetooth module allows it to receive various commands through Bluetooth. Bluetooth devices can scan and detect other devices. It also checks the working of devices. The system has an illumination sensor that turns on the light when the external light is dull. The disadvantage of the system is that the Bluetooth being around 10 meters only. The system has the ability to fit into an existing system.

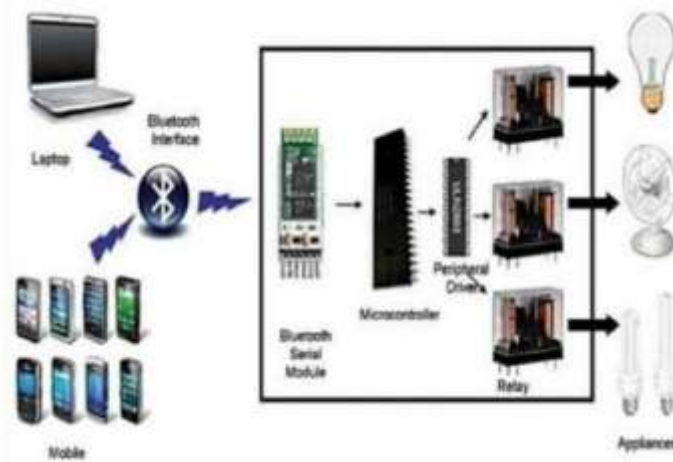


Figure3:Bluetooth based smart home technology

The system uses a cell phone and Bluetooth technology for controlling the home devices like lights, and fans as illustrated in the figure. In this system, an Arduino Bluetooth board is used and Bluetooth is used to send information regarding the home appliances to the cell phone. The cell phone contains the software program for the user interface. Bluetooth has a bandwidth of 2.4GHz, a range of 10 to 100m. The devices are connected through relays to the Arduino board. Reports are sent after a single toggle. The system also has a password for security and protection and is used by the authorized user only. The disadvantage of the system is the limited range of Bluetooth for monitoring the devices.

D. Wi-Fi-based Smart Home Technology

The system uses Wi-Fi for controlling and monitoring home appliances through the Internet of Things(IoT). It makes use of an Open system

Gateway Interface(OSGi). The user interface layer makes use of browsers and PC applications. Speech based commands are sent to the user for monitoring the devices. The system also contains integrated control modules and universal plugs uses many standard protocols for the inter operation of the device. The system is implemented by using the Linux platform and has ability to share the services.

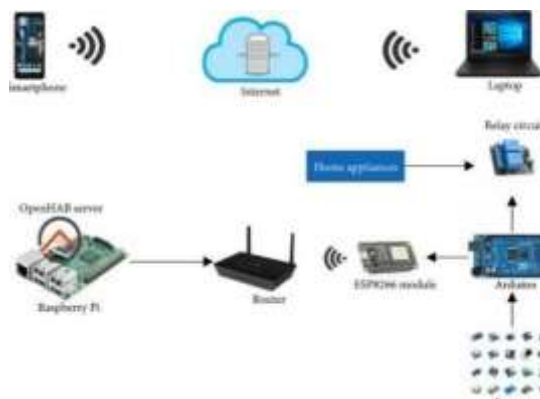


Figure4:Wi-Fi-based smart home technology

The smart home technology has an Arduino board with Wi-Fi technology. The system uses a smartphone to communicate with the PC at home. The PC acts as the server that controls the Arduino board. The system has remote access through the phone. The wi-Fi-based system is energy efficient and saves time and automates tasks. It also has enhanced security and protection. The disadvantage is that the PC needs to be on all the time and the internet is always accessible from the Wi-Fi which is not reliable.

DISCUSSION

This section of the paper contains a comparison of the above-described home automation systems. The systems that are discussed contain some common features and communication technology, advantages, and drawbacks. All the control circuits have a command system to issue commands to the controller board. The interface determines the interactions of the user with the system and controls the devices of the users. The user interface influences the usability of the system. Most home automation systems have security features to protect them from intruders and access only for authorized users.

Comparison of the above-described systems is shown in Table 1. The types of methodology seen from the above discussion are GSM, ZigBee, Bluetooth, and Wi-Fi.

Table1: Comparison of all smart home technologies

System	Primary Communication	Speed	RealTime
GSM	SMSmessages	Slowdue to delivery issues	No
ZigBee	ZigBee and ATcommands	Fast	Yes
Bluetooth	Bluetooth and commands	Fast due toproximity	Yes
Wi-Fi	Infrared, Radioorotherwaves	Slow due tointerferences	Yes

In GSM-based smart home technologies, communication is done through the SMS messages to the commands issued from the main control systems. The system can control and monitor from anywhere in the world. But the implementation cost can vary depending on the location and distance between them. One of the disadvantages is it lacks reliability because It has no assurance of the delivery of the messages to the system. Thus, it cannot be used as real-time systems.

In ZigBee-based systems, the technology is similar to Bluetooth technology. But it is a new technology. It uses either the PC or mobile phone as the receiver. It can control home appliances as long as the user is at home. ZigBee has between a physical range of 10 to 20 meters. It can be used in real-time systems. It has advantages and disadvantages similar to the Bluetooth-based systems.

ABluetoothsystemhascompletecontroloverdevicesathomeaslongastheuserisinBluetoothnetwork.The speed of communication is high. It has significant security from unauthorized users. The drawback of the system is that it cannot be controlled outside the home and the range of the appliances is only around 10 meters.

Wi-Fi-based smart home technology users radio frequency waves and infrared waves. It can be used in real-time systems. The drawback is the range and availability of the spectrum. Radio waves have larger grand offer good options for their more access. But, the availability of the spectrum must be considered.

Many systems are present that use different methodologies to compensate for the disadvantages of each. But it affects the implementation cost and the possibility of redundancy. Commonly used user interfaces are smartphones and web applications to control smart home technologies.

CONCLUSION

Based on all the systems discussed and their advantages and disadvantages, this paper represents the features to be required by an ideal system for smart home technology with remote access. The system should be available from all over the world to a user and it should be a real-time application. The GSM network should contain the internet to ensure that access is available all the time. The user interface should be a web application that is associated with the mobile application, so all the users can access the system. The future scope for smart home technology involves making the home smarter and more convenient. For future work, it is suggested to develop image processing-based smart home technology using the above-discussed technologies. In such an automation system, home appliances will be controlled by different gestures which will be detected through the camera. Moreover, the home automation system can be developed by interfacing biomedical signals such as Electro myography signals with a computer, it will provide an opportunity for an amputee to control appliances from different arm gestures. It can be used for fueling robotics areas for controlling robots through gestures for different tasks.

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